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RECENT TRENDS IN SOVIET RESEARCH

Stuart G. Hibben, et al

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This is a brief collection of abstracts on a variety of recently noted R & D topics from the Soviet technical and popular press. Items were selected as being of topical interest, but not necessarily covered in the assigned subject areas of this contract.

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INTRODUCTION

This is a brief collection of abstracts on a variety of recently noted R & D topics from the Soviet technical and popular press. Items were selected as being of topical interest, but not necessarily covered in the assigned subject areas of this contract.

A. Abstracts

Bunkin, F. V. Optothermodynamics: a new direction in laser physics. ZhETF P, v. 19, no. 5, 1974, 302-305.

The correlation between laser pulse shape and its desired effect on a given target material has been treated in some specific cases (see for example Gurvich, Effects of High Power Lasers, No. 2, 1973, p. 114). More recently the question of pulse shape has become critical in the problem of laser heating and compression of a target plasma to achieve thermonuclear fusion. In the present paper the author investigates the more general case of programming a laser waveform so as to achieve a desired change in state of the target material with the greatest economy in net pulse energy. The implication is that a wide range of laser-induced reactions may thus be attainable at easily reached energy levels, without the technical demands of very high power systems.

The author postulates an optical method for transforming a substance to a supercritical state, specifically within the neighborhood of a given critical point. Laser radiation is assumed to be focused on a liquid of known absorption coefficient and equation of state $V = V(p, T)$, where V = unit volume. The effect is confined to a cylindrical liquid element in the focal region, of length $L >>$ radius, a. The question then is to determine the laser pulse form required to convert the element from its initial state (p_o, V_o) to a given final state (p_1, V_1).

The problem is illustrated in the p-V plane of Fig. 1, in which the solid curves are isotherms. Several possible routes from initial O to desired K (encircled) are indicated, i.e. OAK, OBK, OCK, or OC'K. Paths OBK and OC'K, having maxima, evidently would require a higher pulse energy. The author examines the path OAK, comprising isochoric segment OA and isobaric segment AK, and arrives at approximate expressions

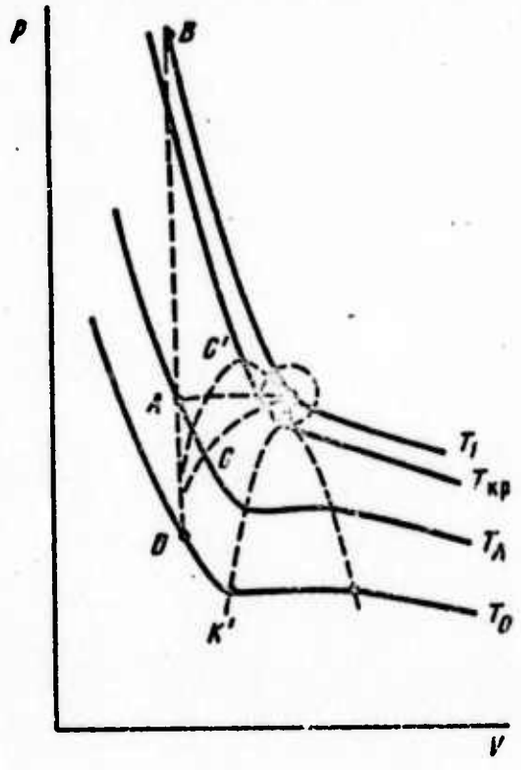

Fig. 1. Possible modes for laser excitation of a liquid.

for laser energies W_{OA} and W_{AK} required for each segment, assuming that total reaction time is substantially less than overall pulse width, τ. For path OAK of Fig. 1 the laser pulse should thus have the energy profile shown in Fig. 2.

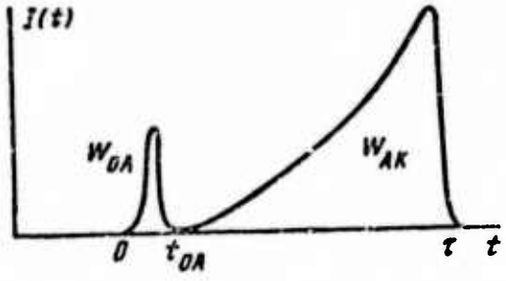

Fig. 2. Pulse energy form for path OAK in Fig. 1.

A numerical example is given for converting ethyl alcohol from a normal state (V_o = 1.26 cm^3/g, p_o = 1 atm, T_o = 293°K) to a supercritical state where T_1 = 520°K, p_1 = 66 atm, and $V_1 = V_{crit}$. The results give energy W_{OA} as 0.1 j, $t_{OA} = 4 \times 10^{-8}$ sec, W_{AK} = 20 j, and overall pulse width $\tau = 4 \times 10^{-7}$ sec. As Bunkin points out, the energy levels involved in such a case are not very high, so that in the practical case economy of pulse energy is not so much the concern as the feasibility of generating a given pulse shape.

Other applications of optothermodynamics are suggested, including high-pressure studies of artificial minerals, optical generation of acoustic signals in liquids, and studies of laser effects on superconducting transitions in alloys.

Ginzburg, V. M., and V. M. Meshchankin. A holographic radar with three-dimensional electronic scanning. RiE, no. 1, 1974, 148-153.

The authors establish the theoretical feasibility of a 3-D holographic radar using conventional r-f wavelengths. The system is based on a plane phased transmitter array as in Fig. 1, where for simplicity only one coordinate of the system is shown.

Constraints on radiator element spacing are given, and expressions are derived for complex signal return in terms of target range, phase shift and other transmitter parameters. With real and imaginary components of the complex return signal displayed, the system would provide phase variation as well as amplitude variation of a target. Another possible variant of Fig. 1 is also shown.

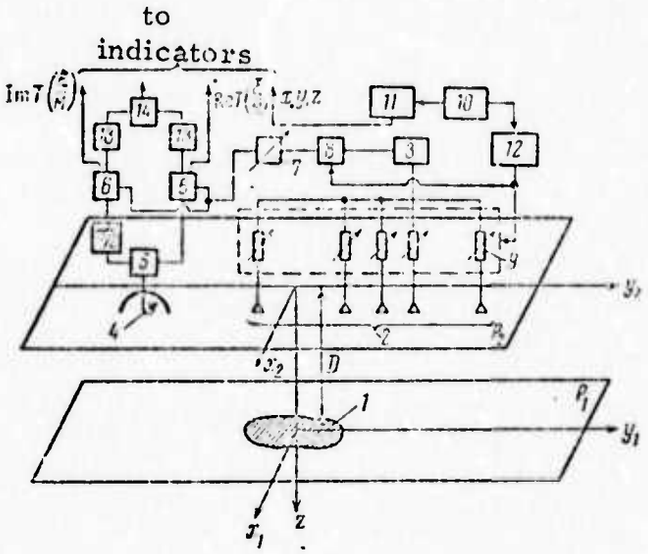

Fig. 1. Holographic radar.

1- target; 2- transmitter array; 3- signal generator; 4- receiving antenna; 5- divider; 6- mixer; 7, 8, 9- phase shifters; 10- synchronizer; 11- sweep generator; 12- phase shift control; 13- squaring circuits; 14- scanning circuit, output to CRT modulator.

As with any such holographic system the useful range is limited to the Fresnel zone; however the resolution obtainable in this limited range could be quite good compared to a standard pulsed radar. The authors give a hypothetical example for their system assuming λ = 1 cm, antenna array width = 3 m and a target range = 50 meters; this would give a target dimensional resolution = 30 cm and range resolution = 3 m, which is stated as unattainable with the usual pulsed radar.

Shmelev, V. Germanium in a cyclotron tandem. Khimiya i zhizn', no. 12, 1973, p. 61.

In a recent effort to synthesize superheavy elements, scientists at the Laboratory of Nuclear Reactions of the Joint Institute of Nuclear Research reportedly accelerated multicharged germanium ions to 8.2-9.2 MeV energy per nucleon in a tandem cyclotron arrangement. The ions passed first through the larger cyclotron, then were stripped and accelerated to their final energy in the smaller. The ion beam intensity at the final radius of the smaller cyclotron was 10^{10} particles/sec. The accelerated ^{76}Ge ions are intended to be used in a nuclear reaction with ^{238}Pu to produce the 310 isotope of the element 126, the most likely stable element of the hypothetical island of stability.

Development of the climatron. Rabochaya gazeta, April 2, 1974, p. 3.

A brief description is given of the impending construction of the climatron, a 30-meter tall glass enclosed complex with a variety of possible internal climatic conditions. Developed by scientists at the Main Botanical Garden and a team of architects from Mosproyect-Z, the climatron is due for construction within a few years.

The building will have the following three sections with differing climates: humid tropical, humid and dry subtropical, and desert. Facilities will be included for generating fog, rain and other weather conditions. Project scientists plan a large exposition of world-wide flora in the climatron, and foresee up to 2,000 types of plant growth, many for the first time under glass.

Basov, Yu. G., V. K. Korovkin, G. M. Panchenkov, and B. U. Utirov. Photochemical separation of isotopes. IAN KirgSSR, no. 2, 1973, 53-59.

This is a review of theoretical and experimental research on the title subject, most of the theoretical research reviewed being papers in Soviet sources published in 1969-70 by Yu. Basov et al.

The authors believe there is a possibility of a nearly 100% isotope separation from the effect of radiation, under certain conditions which are cited. Calculation of the separation factor α shows that a significant separation can be achieved, if the difference in excitation frequencies of two isotopic molecules approaches the spectral line width of a selected light source at the excitation frequency of one isotope molecule. The isotope effects in photochemical reactions are compared with these in electric discharge-induced reactions in the gas phase. The photoabsorption and photodissociation mechanisms of chemical reactions are described, and the isotope effects from photoabsorption in gases are evaluated. The evaluations indicate high α values, e.g. 1.10-1.22 for hydrogen isotopes, in contrast to α values as low as 1.02-1.04 for photodissociation. The review of numerous non-Soviet experimental studies showed good results obtained by electron spectral excitation, e.g. in separation of Hg isotopes.

Analysis of the reviewed data from the literature led to the conclusion that application of the photochemical method shows promise with respect to a complete isotope separation of many elements. Procedural simplicity and a great efficiency are the main advantages of photochemical separation. The problem of providing a resonant source at different excitation wavelengths is seen as solvable either by use of a laser or an optical source filled with a molecular gas of one of the isotopes.

Basov, Yu. G., B. U. Utirov, and V. K. Korovkin. On the possibility of photochemical separation of isotopes. ZhFKh, no. 2, 1974, 342-345.

Three conditions necessary for a substantial isotope enrichment by monochromatic irradiation are examined in terms of their effect on the isotope separation factor α. The first condition for preferential excitation of only one isotope is given by the α formulation as the ratio of the excitation rate constants of two isotope particles to the i-th quantum level. The rate constants k_i' and k_i'' are determined from the Pauli equation.

The second condition is that the optical absorption frequencies of two isotopes be sufficiently different. In this case, α is calculated as the ratio of the absorption line width of the resonance excited isotope to the difference of resonance frequencies of the two isotopes. Third and most important is the condition of the chemical reactivity of the selectively excited isotope. This condition can be verified by calculating α as the ratio of the reaction rate constants of the two isotopes with a third reactant. In an open flow system, an additional condition for complete separation is that the reaction rate constant of the excited isotope is equal to the flow rate of this isotope at normal temperature and pressure.

The use of laser radiation in photochemical separation of most isotopes is considered difficult because dissociation activation energy of many gas molecules is too great to allow their breakdown by visible or IR laser radiation. The high α values obtained in early experiments with separation of Hg isotopes by means of light sources filled with one of the Hg isotopes are supported theoretically. The experimental fact that α obtained in isotope separation using nonresonance radiation is much greater than α of isotopes in an electrical discharge is explained by the difference in velocity distribution function of photons and electrons.

Arnbartsumyan, R. V., V. L. Letokhov, G. N. Makarov, and A. A. Puretskiy. Laser separation of nitrogen isotopes. ZhETF P, v. 17, no. 2, 1973, 91-94.

This paper describes the first highly efficient experimental separation of isotopes with the use of laser radiation, in which separation of ^{14}N from ^{15}N was achieved by a two-step selective photodissociation of $^{14}NH_3$ and $^{15}NH_3$ molecules. The experiments are described in which the 947.74 cm^{-1} radiation from a transverse discharge, tunable CO_2 laser selectively excites the $1 \rightarrow 0$ vibrational transition in $^{15}NH_3$ molecule and simultaneously the 45351 cm^{-1} UV radiation from an electric discharge in air dissociates the vibrationally-excited $^{15}NH_3$ molecule. The laser pulse energy was 60 mj, the pulse half-width 300 nsec, and the UV pulse duration, 400 nsec. The 1:1 mixture of $^{14}NH_3$ and $^{15}NH_3$ was irradiated at 20 torr pressure. The photodissociation mechanism of the vibrationally excited molecules is explained. The experimental I_{29}/I_{30} ratio of the mass spectral lines of $^{14}N^{15}N$ and ^{15}N molecules in the product of selective photodissociation was found to be 0.5 ± 0.05 versus $2 \pm 5\%$ for nonselective dissociation (without laser radiation). The ^{15}N isotope enrichment factor was calculated to be 4, i.e., an N_2 molecule in the product contained 80% ^{15}N and 20% ^{14}N atoms, as opposed to the equal concentrations of these atoms in the starting NH_3 mixture. The intensity of the UV source and the irradiation time are the main factors determining the number of the photodissociated $^{15}NH_3$ molecules. The dissociated level of NH_3 molecules in this case is given as a few percent.

Ambartsumyan, R. B., V. S. Letokhov, G. N. Makarov, and A. A. Puretskiy. Nitrogen isotope separation by two-step selective photodissociation of ammonia molecules. DAN SSSR, v. 211, no. 2, 1973, 365-368.

This is an expanded report on separation of ^{15}N from ^{14}N isotopes by application of the title method. The expansion includes selective photodissociation of a 1:1:2 mixture of $N^{14}H_3$-$N^{15}H_3$-O_2 at a total 40 torr pressure, in addition to the photodissociation of the 1:1 mixture of $N^{14}H_3$-$N^{15}H_3$ which was described earlier by the authors (see foregoing paper).

The mass spectra of N_2 in the products of a two-step selective photodissociation of a $^{14}NH_3$-$^{15}NH_3$-O_2 mixture show that only the I_{30} line increases. The ^{15}N enrichment factor is therefore higher than 20^2, i. e. the N_2 in the product contains at least 95% of ^{15}N atoms. This result is interpreted in terms of buffer and NH_2 radical acceptor effects of O_2, which decrease the vibrational energy transfer from $^{15}NH_3$ to $^{14}NH_3$, and hence increase the selectivity of photodissociation to nearly 100%. In contrast, measurements during laser pumping of the $^{14}NH_3$-$^{15}NH_3$ mixture indicate that 20% of the vibrational energy absorbed by $^{15}NH_3$ is transferred to $^{14}NH_3$ molecules. About 20% of the $^{14}NH_3$ molecules are photodissociated as the result of this transfer in the $^{14}NH_3$-$^{15}NH_3$ mixture.

Belenov, E. M., Ye. P. Markin, A. N. Orayevskiy, and V. I. Romanenko. Isotope separation by infrared laser radiation. ZhETF P, v. 18, no. 3, 1973, 196-198.

This is a theoretical treatment of the problem of medium-to heavy-mass isotope separation using infrared laser radiation to selectively stimulate a chemical reaction. It is assumed that the laser radiation frequency coincides with that of the 0—1 transition of one isotope in a mixture. Kinetic

equations are developed which describe population shift between molecular levels, taking into account the v-v relaxation process. Solution of the set of kinetic equations in the case of a concentration N_1 of type 1 molecules > N_2 of type 2 molecules led to the formula

$$\frac{\gamma^{(2)}}{\gamma^{(1)}} = \exp \frac{\mathcal{E}}{T} \frac{(\nu_1 - \nu_2)}{\nu} \quad . \tag{1}$$

which gives the ratio of the reaction rates of two isotopes as the function of the reaction activation energy ϵ, translational temperature T, and vibrational frequencies ν_1 and ν_2 of the two isotopic molecules. Eq. (1) shows that the $\gamma^{(2)}$ and $\gamma^{(1)}$ values can be very significant in reactions with a high ϵ and a small T. An example of calculation gives $\gamma^{(2)} = 10\,\gamma^{(1)}$ for a difference of isotope masses $\Delta m/m = 1/20$; $\epsilon = 2$ eV; $T = 300^{\circ}$ K; and $h\nu = 0.1$ ev for a CO_2 laser. This example illustrates the possibility of an efficient isotope separation by a laser-stimulated selective chemical reaction. The separation is however conditional on a sharp difference between vibrational temperature of the excited molecular mode and T at energy = ϵ.

Demchenko, P. A., L. I. Krupnik, and N. G. Shulika. Propagation of dense plasma fluxes in metallic plasma guides. ZhTF, no. 12, 1973, 2535-2539.

Results are given of an experimental study of dense plasma fluxes propagating along metallic cylindrical plasma guides or liners, as compared with a freely exparding plasma in the absence of a magnetic field. In the case of propagation in cylindrical plasma guides the mean free path λ of plasma charged particles with respect to Coulomb interactions was much shorter than the plasma guide cross-section dimension D = 10 cm.

The experimental apparatus is described. Accelerated hydrogen plasmoids were generated by a conical plasma injector, then injected into a vacuum chamber directly or through a plasma guide.

The results show a sharp difference in plasma structure among the cited configurations. The plasma flux propagating in the cylindrical plasma guide exhibits a complex structure due to interaction with the metallic walls. A dense plasma boundary layer with a low ionization forms at the wall, having a total particle density many times that at the system's axis. The practical importance of this finding is stressed.

Rudenko, O. V. Parametric interaction of traveling acoustic waves. Akusticheskiy zhurnal, no. 1, 1974, 108-111.

A simplified solution is obtained for the Burgers equation which describes sound propagation in a nondispersive medium, with allowance for three-wave parametric interaction and absorption. Spectral analysis, in approximation of a degenerate parametric system $\omega_3 = \omega$, $\omega_1 = \omega_2 = \omega/2$, is used to describe the initial parametric process, when pump wave (ω_3) attenuation can be neglected. The resulting set of two simplified equations shows that maximum gain is achieved at the initial phase shift $s(0) = \pi/2$ and high acoustic Reynolds numbers $R_e = C_o\rho_o V_o/b\omega$. Under these conditions, nonlinear effects are the strongest and pump energy is transferred into a subharmonic most effectively.

A graphical method is then applied to the entire interaction process; it is shown graphically that, at an initial signal amplitude $V_1(0) = 0.2$ and $S(0) = \pi/2$, the initial asymmetry of the wave profiles is increased and the initial wave is converted to a sawtooth wave at $\omega/2$ fundamental frequency. At $V_1(0) = 0.2$ and $S(0) = 0$, symmetrical fronts are formed. The graphical analysis shows variations of the pump and signal wave amplitudes $V_3/\pi(2)$ and $V_1(\pi/2)$ in both cited cases.

Merzhiyevskiy, L. A., and Yu. I. Fadeyenko. Rupture of a liquid-filled thin wall pipeline from meteorite impact. Kosmicheskiye issledovaniya, no. 6, 1973, 944-951.

Experiments with simulated meteorite impact on pipelines of a spacecraft are described, and the results are analyzed using empirical formulations for the rupture mechanism of metallic plates. The formulas are derived on the basis of existing literature, including the authors' own data.

In the simulation experiments, 0.3 to 2 mm thick duralumin or steel tubes, filled with water, were bombarded with 0.8-2.5 mm diam. steel pellets impelled by a hollow charge to 3-9 km/sec velocity. Four types of rupture may be observed, depending on dimensions and speed of the pellets. The threshold thickness δ_o of a through puncture of a filled tube and the hole diameter D in the wall are found to coincide with the earlier determined δ_o and D in a plate. The kinetic energy E of the impactor is shown to be the determining factor of rupture. The diagrams of rupture types can be used to predetermine rupture characteristics without an experiment. Computation based on a quasi-one dimensional problem indicated that the impact generated shock wave degenerates rapidly into a weak acoustic wave in distances as short as $\geq$ 10 pellet radii from the impact site.

Shubova, R. L., V. F. Shul'ga, and Yu. M. Yampol'skiy. Apparatus for measuring variations of ultra-long wave signal parameters at spatially distributed points. IVUZ Radioelektronika, no. 12, 1973, 83-85.

A compensator type two-channel phasemeter is described for measuring amplitude and phase of 10-20 kHz signals from one point,

or phase difference $\Delta\varphi$ between signals from two or three geographic points. The phasemeter includes a phase AFC system in which the frequency of the received signal is mixed with the frequency of a rubidium standard used as a reference oscillator. In contrast with the Ch 1-29 and Ch 7-4 receivers, a modulation type phase detector is used. The a.c. output signal of the detector eliminates the need for a narrow-band selectors, thus eliminating the main source of error.

Results are given of calculations, system analog simulation, and laboratory tests for the effect of noise interference on the recording accuracy. The error of $\Delta\varphi$ recordings was found to be $\sigma_{\Delta\varphi} = 1^{\circ}$ in the case of radio relay stations located within sighting range. The main technical features of the system are also given.

Bunin, V. A. A signal transmitting and receiving system, using gravitational waves. Author's Certificate SSSR, no. 347937, published Oct. 11, 1972 (RZhF, 1/74, no. 1B122 P). (Translation).

The subject system consisting of an emitter and a receiver is introduced. The gravitational wave transmitter is a solid cylinder suspended in vacuum with a piezoelectric sensor of mechanical oscillations, which is fastened to the cylinder or clamped between sections of it. Selection of appropriate cylinder dimensions ensures resonance of mechanical, electrical, and gravitational oscillations. The transmitter is enclosed in a shield with internal cooling and is mounted on a suspension which serves as an acoustic filter. Gravitational waves incident on the receiver create a mechanical strain which causes deformation of its piezoelectric pickup and ultimately generates an electric output signal. The transmitter is excited by a modulated source of mechanical or acoustic oscillation. To increase output

power of the transmitted signal, dimensions of the electromagnetic to mechanical oscillation converter are preferably selected in a way to ensure spatial resonance, i.e., equality of phase velocities of the interconvertible oscillations. (Note: an earlier disclosure of a similar system was reported by Bunin in Soviet Research on Gravitational Radiation, Aug. 22, 1973, p. 32).

Gulyayev, Yu. V., A. A. Grinberg, N. I. Kramer, A. P. Korolyuk, V. F. Roy, and E. M. Epshteyn. Acoustomagnetoelectric effect. Otkr. izobr, 48/73, diploma no. 133, claim file no. OT-8018, Sept. 10, 1971.

The subject of this disclosure is the phenomenon of magneto-acoustical induction of a transvers e.m.f. in a solid conductor placed in a magnetic field. The induced e.m.f. is generated by acoustic wave interaction with charge carriers in different energy states. The discovery offers a very sensitive method of investigating energy states of free charge carriers. From a practical viewpoint, it presents a theoretical basis for development of sensitive ultrasonic detectors, as well as a method for extreme cooling of a substance.

Ivanov, A. A., Yu. S. Sigov, and Yu. V. Khodyrev. Nonlinear theory of plasma heating by high-frequency radiation. DAN SSSR, v. 214, no. 6, 1974, 1291-1294.

Results are presented of a one-dimensional numerical experiment with collective processes in a Vlasov plasma, interacting with a strong e-m wave of a frequency near the plasma electron frequency. The

plasma is considered to have an initial Maxwellian distribution of components and periodic boundary value conditions over some finite length L of a plane plasma layer. The nonlinear mechanism of plasma heating with instability development is studied for the cases of initial $T_{eo} = T_{io}$ and $T_{eo} > T_{io}$. Instability is considered as a breakdown of a transverse wave having a wave number $k_o = 0$ into a Langmuir wave and an ion-acoustic wave.

For the case of $T_{eo} = T_{io}$, under certain plasma parameters, Langmuir mode oscillations build up, while ionosonic oscillations rapidly decay. A high noise level results in intensificationof the short-wave vibrational spectrum by the mechanism of parametric buildup of new modes (secondary wave instability).

At $T_{eo} > T_{io}$, damping of ion oscillations is slow and a standing ion acoustic wave arises in the plasma layer. Simultaneously, particles are ejected by h-f pressure from the region with maximum Langmuir wave amplitude. As a consequence, the wave spectrum acquires more short-wave pulsations by the mechanism of plasmon condensate formation. In both cases, the end result of the interaction is a fairly broad noise continuum which extends the electron distribution function into the high phase velocity region, thus contributing to a fast heating of electrons on account of quasilinear diffusion.

Illustrative theoretical plots show that an intense heating of electrons sets in and the ion distribution function becomes noticeably distorted. In all numerical calculation variants the initial ion heating by nonlinear scattering of Langmuir oscillations is less efficient than quasilinear heating of electrons. It follows that the $T_e > T_i$ situation is characteristics of h-f heating of the plasma. The number of fast non-Maxwellian electrons was calculated to be 2.5% of the total number. The described technique made it possible to observe initial pump energy transfer to long waves with $k < k_{max}$. This is interpreted as the evidence of a modulation instability.

Lychagin, N. I. On changes in properties of magnetized water. IVUZ Fiz., no. 2, 1974, 99-103.

The effect of a magnetic field H on aqueous systems is studied theoretically, with allowance made for the aggregate structure of water molecules. It is shown mathematically that reciprocal spatial orientation of electron orbitals may be modified by interelectron interaction and the field H, hence H may directly affect water molecules by changing their dipole moment. An increase in dipole-dipole interaction between water molecules promotes formation of larger and more stable molecular aggregates.

The change of aggregate volume from the effect of H is evaluated from Bachinskiy's formula

$$\eta = \frac{C}{v - \omega}, \qquad (1)$$

where η and v are viscosity and specific volume of a nonassociated liquid, respectively, ω is the volume of water molecules near the melting point, and $C = 0.80705 \times 10^{-3}$. Equation (1) is modified to take into account aggregate disintegrating at increasing temperatures to 100° C. Consequently, ω, and hence η decrease with increase in temperature, in agreement with the handbook data for water η.

It is concluded that water property is a function of its aggregate structure. Using the experimental water density and η data from the literature, the author calculates that the aggregate volume in a magnetic field increases by 0.2%. Simultaneously, the lifetime of molecular aggregates increases. The remanence of the magnetized state persists after H is removed until the aggregates disintegrate owing to molecule thermal motion. Changes in dielectric constant and IR spectrum intensity of magnetized water and the solubility rate of nonpolar molecules in magnetized water are also evaluated.

Grishchenko, Ye. K. Modulation of sound by light. Akusticheskiy zhurnal, no. 1, 1974, 128-129.

The possibility of modulating acoustic energy density was investigated in an acoustic line, by optically altering the acoustic impedance of the back loading of photosensitive piezosemiconductor emitters. One of the possible variants of such modulation is shown in Fig. 1. During

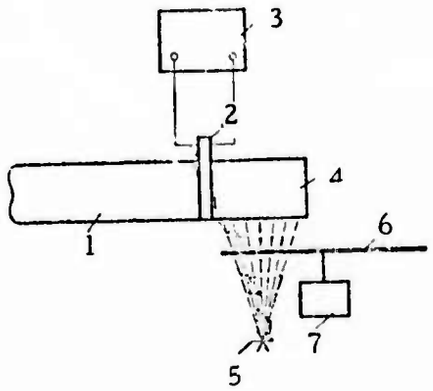

Fig. 1. Optical modulation scheme.

1- Acoustic line; 2- piezo emitter; 3- hf-generator; 4- back loading of piezo plate; 5- light source; 6- chopper; 7- drive motor.

illumination of the back load, the complex modulus of elasticity of the piezosemiconductor crystal changes owing to its photoelectric properties, such that during transition from the dark to illuminated state, the relative change in elastic modulus is of the order of the square of electromechanical coupling coefficient of the crystal. For CdS, for example, this value equals 1-2%. If the length of CdS crystal back load (4) equals 50-100 wavelengths, then the transition from dark to illuminated state will develop an appreciable change in acoustic impedance of the back load and consequently an effective sound emission in the acoustic line.

The suggested method has been experimentally verified, showing that effective sound modulation by light is practically realizable. A description of the experimental procedure is outlined in detail.

Ostrovskiy, L. A., and Ye. N. Pelinovskiy. Nonlinear waves in inhomogeneous media with dissipation. IN: Sb. Probl. difraktsii i rasprostr. voln. no. 12, Leningrad, Leningr. un-t, 1973, 44-51. (RZhF, 1/74, no. 1Zh14). (Translation)

Averaged equations are derived by means of an asymptotic method for wave processes in nonlinear dissipative media with arbitrary dispersions. This permits investigation of processes connected with wave transformations due to medium inhomogeneity and energy dissipation in the system. Transformation processes are discussed of sinusoidal waves into a succession of solitons on a liquid surface in a zone with decreasing depth. The effect of dissipation on the propagation of certain types of waves are outlined. Results of the analysis are compared with those of experiments.

Gavrilenko, V. G., G. A. Lupanov, and N. S. Stepanov. Propagation of electromagnetic waves in inhomogeneously moving media. IN: Sb. Probl. difraktsii i rasprostr. voln. No. 12. Leningrad, Leningr. un-t. 1973. 129-134. (RZhF, 1/74, no. 1Zh142) (Translation)

Two effects are discussed: 1) reflection of e-m waves from a region with lateral drift velocity gradient, and 2) instability of surface

waves, propagating along jet flows in plasma. An expression is obtained for reflection coefficient at the boundary of stationary and moving plasmas. Dispersion equations are derived for surface waves propagating along the jet in a stationary plasma, and their solutions are shown to be unstable. A general case is also considered for which the velocity gradient of the motion has a defined limit.

Vardanyan, R. A., and B. I. Ivlev. Effect of laser radiation on superconductivity. ZhETF, v. 65, no. 6, 1973, 2315-2326.

This is a theoretical analysis of the nonequilibrium state created by single-sided laser illumination of superconducting thin or thick films. The magnitude of the magnetic vector is assumed to be less than superconductivity destruction threshold, so that the Joule effect from radiation is insignificant. In each case the quasiparticle distribution function $n(\epsilon)$ was evaluated from the Eliashberg kinetic equation and an exact formula of the energy gap variation $(\Delta_o - \Delta/\Delta_o)$ caused by the nonequilibrium addition of $n'(\epsilon)$ to $n(\epsilon)$ was derived in the framework of the BCS theory in agreement with the Rothwarf-Taylor phenomenological theory.

In the case of a thin film of thickness d less than the optical penetration depth δ, it is shown that at temperature $T \leq \Delta$ the major part of $n'(\epsilon)$ is localized directly above the threshold and $(\Delta_o - \Delta)/\Delta_o$ depends on T at a given radiation power. In the cases of a thick film $(d > \delta)$ a diffusional term added to the Eliashberg equation accounts for spatial inhomogeneity. It is shown that in the latter case, $n'(\epsilon)$ and Δ over a sufficiently long distance and low T depend on the coordinate z. The main feature of the derived solutions is a high δ which is many times greater than the superconducting coherence length $\xi_o = (D/\Delta)^{1/2}$. The temperature dependence of $\Delta_o - \Delta(z)/\Delta_o$ is different from that in the case of a thin film,

with the maximum being at T_o, when $\delta = z_{max}$. Criteria for applicability of the derived formulas are given.

The behavior of superconducting films is further analyzed in particular cases of increased numbers of quasiparticles owing to electron-electron interaction and at radiation frequency equal to Δ. In agreement with the experiment in the former case superconductivity is inhibited by laser radiation at a high pump frequency, and in the latter case, nonlinear properties are enhanced.

Mende, F. F., N. N. Prentslau, O. P. Kozlovskiy, and I. N. Bondarenko. Using superconducting resonators for highly sensitive FM detection. IN: Tr. Fiz.-tekhn. in-t nizk. temperatur AN USSR, no. 22, 1973, 80-84. (RZhF, 11/73, no. 11Zh392). (Translation)

A method is described which makes it possible to increase sensitivity significantly and also widen the measurable deviation bands for FM detection. The principle used is the transfer of fluctuations to the r-f region, which does not require a heterodyne SHF generator. Frequency conversion is obtained in converters in which a superconducting resonator is used in the form of a passive frequency standard. The conversion factor of SHF fluctuations in r-f regions for type one converters is close to unity, and for type two, $\sim 10^2 - 10^3$.

Mende, F. F., A. I. Ivanov, and V. D. Sinenko. Investigating the properties of superconducting helical resonators. IN: ibid., 27-34. (RZhF, 11/73, no. 11Zh372). (Translation).

Superconducting helical resonators were studied theoretically and experimentally in the 50-400 MHz frequency range. Resonant frequency and frequency dependence of the Q-factor are calculated. Resonator construction and experimental procedures are described, and test results are presented. The Q obtained was found significantly higher than that of the usual helical resonators, reaching values of 0.42×10^6.

Kulinyak, D. Stronger than steel [basalt fiber] Promyshlennost' Byelorussii, no. 4, 1974, 52.

Properties are described of basalt fibers produced at a Kiyev research laboratory for structural materials. The fiber composition is stronger than steel, shows exceptional vibration isolation properties and a temperature insulation range from -260 to $+1000^{\circ}$, as well as resistance to chemical attack. While many special applications are foreseen for basalt fiber, such as in spacecraft, its more immediate use as a common building material is proposed. A 5-cm thick panel of pressed basalt fiber has sound and heat isolation properties equal to a brick wall one meter thick; it is estimated that an average apartment room with this type of panelling would weigh only a few dozen kilograms. With a virtually limitless supply of basalt available, production of the fiber material is predicted to begin on a large scale.

B. Recent Selections

Arabyan, M. K. Radioholographic antennas. IN: Sb. Vopr. standartiz., metrol. i tekhn. tochnykh izmereniy. Moskva, Izd-vo standartov, 1973, 209-212. (RZhF, 2/74, no. 2Zh274)

Arutyunyan, Dzh., and A. S. Arutyunyan. Aligning an antenna by optical modelling of the radiation pattern. IN: ibid., 174-177. (RZhF, 2/74, no. 2Zh296).

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Krymskiy, G. F., and L. A. Transkiy. On shock wave propagation in interplanetary space. GiA, no. 6, 1973, 1011-1019.

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Kulinyak, D. Stronger than steel [Basalt fiber]. Promyshlennost' Belorussii, no. 4, 1974, 52.

Letokhov, V. S., and Yu. Ye. Lozovik. Vliyaniye sil'nogo magnitnogo polya na khimicheskiye reaktsii pri nizkikh temperaturakh. (Effect of a strong magnetic field on chemical reactions at low temperatures). Moskva, 1973, 16 p. (KLDV, 3/74, no. 4159)

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Mende, F. F., I. N. Bondarenko, and I. B. Iyevenko. Highly stable tunable SHF generator with superconducting resonator. IN: Tr. Fiz.-tekhn. in-t nizk. temperatur AN USSR, no. 22, 1973, 48-57. (RZhF, 11/73, no. 11Zh15).

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SOURCE ABBREVIATIONS

AiT	-	Avtomatika i telemekhanika
APP	-	Acta physica polonica
DAN ArmSSR	-	Akademiya nauk Armyanskoy SSR. Doklady
DAN AzSSR	-	Akademiya nauk Azerbaydzhanskoy SSR. Doklady
DAN BSSR	-	Akademiya nauk Belorusskoy SSR. Doklady
DAN SSSR	-	Akademiya nauk SSSR. Doklady
DAN TadSSR	-	Akademiya nauk Tadzhikskoy SSR. Doklady
DAN UkrSSR	-	Akademiya nauk Ukrainskoy SSR. Dopovidi
DAN UzbSSR	-	Akademiya nauk Uzbekskoy SSR. Doklady
DBAN	-	Bulgarska akademiya na naukite. Doklady
EOM	-	Elektronnaya obrabotka materialov
FAiO	-	Akademiya nauk SSSR. Izvestiya. Fizika atmosfery i okeana
FGiV	-	Fizika goreniya i vzryva
FiKhOM	-	Fizika i khimiya obrabotka materialov
F-KhMM	-	Fiziko-khimicheskaya mekhanika materialov
FMiM	-	Fizika metallov i metallovedeniye
FTP	-	Fizika i tekhnika poluprovodnikov
FTT	-	Fizika tverdogo tela
FZh	-	Fiziologicheskiy zhurnal
GiA	-	Geomagnetizm i aeronomiya
GiK	-	Geodeziya i kartografiya
IAN Arm	-	Akademiya nauk Armyanskoy SSR. Izvestiya. Fizika
IAN Az	-	Akademiya nauk Azerbaydzhanskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh i matematicheskikh nauk

IAN B	-	Akademiya nauk Belorusskoy SSR. Izvestiya. Seriya fiziko-matematicheskikh nauk
IAN Biol	-	Akademiya nauk SSSR. Izvestiya. Seriya biologicheskaya
IAN Energ	-	Akademiya nauk SSSR. Izvestiya. Energetika i transport
IAN Est	-	Akademiya nauk Estonskoy SSR. Izvestiya. Fizika matematika
IAN Fiz	-	Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya
IAN Fizika zemli	-	Akademiya nauk SSSR. Izvestiya. Fizika zemli
IAN Kh	-	Akademiya nauk SSSR. Izvestiya. Seriya khimicheskaya
IAN Lat	-	Akademiya nauk Latviyskoy SSR. Izvestiya
IAN Met	-	Akademiya nauk SSSR. Izvestiya. Metally
IAN Mold	-	Akademiya nauk Moldavskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh i matematicheskikh nauk
IAN SO SSSR	-	Akademiya nauk SSSR. Sibirskoye otdeleniye. Izvestiya
IAN Tadzh	-	Akademiya nauk Tadzhikskoy SSR. Izvestiya. Otdeleniye fiziko-matematicheskikh i geologo-khimicheskikh nauk
IAN TK	-	Akademiya nauk SSSR. Izvestiya. Tekhnicheskaya kibernetika
IAN Turk	-	Akademiya nauk Turkmenskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh, khimicheskikh, i geologicheskikh nauk
IAN Uzb	-	Akademiya nauk Uzbekskoy SSR. Izvestiya. Seriya fiziko-matematicheskikh nauk
IBAN	-	Bulgarska akademiya na naukite. Fizicheski institut. Izvestiya na fizicheskaya institut s ANEB
I-FZh	-	Inzhenerno-fizicheskiy zhurnal

IiR	-	Izobretatel' i ratsionalizator
ILEI	-	Leningradskiy elektrotekhnicheskiy institut. Izvestiya
IT	-	Izmeritel'naya tekhnika
IVUZ Avia	-	Izvestiya vysshikh uchebnykh zavedeniy. Aviatsionnaya tekhnika
IVUZ Cher	-	Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya
IVUZ Energ	-	Izvestiya vysshikh uchebnykh zavedeniy. Energetika
IVUZ Fiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Fizika
IVUZ Geod	-	Izvestiya vysshikh uchebnykh zavedeniy. Geodeziya i aerofotos"yemka
IVUZ Geol	-	Izvestiya vysshikh uchebnykh zavedeniy. Geologiya i razvedka
IVUZ Gorn	-	Izvestiya vysshikh uchebnykh zavedeniy. Gornyy zhurnal
IVUZ Mash	-	Izvestiya vysshikh uchebnykh zavedeniy. Mashinostroyeniye
IVUZ Priboro	-	Izvestiya vysshikh uchebnykh zavedeniy. Priborostroyeniye
IVUZ Radioelektr	-	Izvestiya vysshikh uchebnykh zavedeniy. Radioelektronika
IVUZ Radiofiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika
IVUZ Stroi	-	Izvestiya vysshikh uchebnykh zavedeniy. Stroitel'stvo i arkhitektura
KhVE	-	Khimiya vysokikh energiy
KiK	-	Kinetika i kataliz
KL	-	Knizhnaya letopis'
Kristall	-	Kristallografiya
KSpF	-	Kratkiye soobshcheniya po fizike

LZhS	-	Letopis' zhurnal'nykh statey
MiTOM	-	Metallovedeniye i termicheskaya obrabotka materialov
MP	-	Mekhanika polimerov
MTT	-	Akademiya nauk SSSR. Izvestiya. Mekhanika tverdogo tela
MZhiG	-	Akademiya nauk SSSR. Izvestiya. Mekhanika zhidkosti i gaza
NK	-	Novyye knigi
NM	-	Akademiya nauk SSSR. Izvestiya. Neorganicheskiye materialy
NTO SSSR	-	Nauchno-tekhnicheskiye obshchestva SSSR
OiS	-	Optika i spektroskopiya
OMP	-	Optiko-mekhanicheskaya promyshlennost'
Otkr izobr	-	Otkrytiya, izobreteniya, promyshlennyye obraztsy, tovarnyye znaki
PF	-	Postepy fizyki
Phys abs	-	Physics abstracts
PM	-	Prikladnaya mekhanika
PMM	-	Prikladnaya matematika i mekhanika
PSS	-	Physica status solidi
PSU	-	Pribory i sistemy upravleniya
PTE	-	Pribory i tekhnika eksperimenta
Radiotekh	-	Radiotekhnika
RiE	-	Radiotekhnika i elektronika
RZhAvtom	-	Referativnyy zhurnal. Avtomatika, telemekhanika i vychislitel'naya tekhnika
RZhElektr	-	Referativnyy zhurnal. Elektronika i yeye primeneniye

RZhF	-	Referativnyy zhurnal. Fizika
RZhFoto	-	Referativnyy zhurnal. Fotokinotekhnika
RZhGeod	-	Referativnyy zhurnal. Geodeziya i aeros"-yemka
RZhGeofiz	-	Referativnyy zhurnal. Geofizika
RZhInf	-	Referativnyy zhurnal. Informatics
RZhKh	-	Referativnyy zhurnal. Khimiya
RZhMekh	-	Referativnyy zhurnal. Mekhanika
RZhMetrolog	-	Referativnyy zhurnal. Metrologiya i izmeritel'naya tekhnika
RZhRadiot	-	Referativnyy zhurnal. Radiotekhnika
SovSciRev	-	Soviet science review
TiEKh	-	Teoreticheskaya i eksperimental'naya khimiya
TKiT	-	Tekhnika kino i televideniya
TMF	-	Teoreticheskaya i matematicheskaya fizika
TVT	-	Teplofizika vysokikh temperatur
UFN	-	Uspekhi fizicheskikh nauk
UFZh	-	Ukrainskiy fizicheskiy zhurnal
UMS	-	Ustalost' metallov i splavov
UNF	-	Uspekhi nauchnoy fotografii
VAN	-	Akademiya nauk SSSR. Vestnik
VAN BSSR	-	Akademiya nauk Belorusskoy SSR. Vestnik
VAN KazSSR	-	Akademiya nauk Kazakhskoy SSR. Vestnik
VBU	-	Belorusskiy universitet. Vestnik
VNDKh SSSR	-	VNDKh SSSR. Informatsionnyy byulleten'
VLU	-	Leningradskiy universitet. Vestnik. Fizika, khimiya
VMU	-	Moskovskiy universitet. Vestnik. Seriya fizika, astronomiya

ZhETF	-	Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhETF P	-	Pis'ma v Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhFKh	-	Zhurnal fizicheskoy khimii
ZhNiPFiK	-	Zhurnal nauchnoy i prikladnoy fotografii i kinematografii
ZhNKh	-	Zhurnal neorganicheskoy khimii
ZhPK	-	Zhurnal prikladnoy khimii
ZhPMTF	-	Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki
ZhPS	-	Zhurnal prikladnoy spektroskopii
ZhTF	-	Zhurnal tekhnicheskoy fiziki
ZhVMMF	-	Zhurnal vychislitel'noy matematiki i matematicheskoy fiziki
ZL	-	Zavodskaya laboratoriya